

Transformational Tools and Technologies (T³) Project

Visual and Inertial Datasets for an eVTOL Aircraft Approach and Landing Scenario

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Motivation

Advances in computer vision are fueled by data



Impactful Open Datasets

ImageNet (2009)

14+ million images labeled by people.

Key role in advancing computer vision across applications like object recognition, image classification, and object localization.

KITTI (2012)

Real-world video, lidar, & GPS in the urban driving context.
Pushing forward the development of computer vision & robotic algorithms targeted at autonomous driving.



NASA is enabling autonomous systems in aviation, but high-quality datasets are unavailable.

We aim to accumulate and curate video & sensor data in online repositories accessible to researchers across NASA and beyond.

We hope to inspire autonomous aviation advances by creating large, diverse, open datasets in an aviation context.

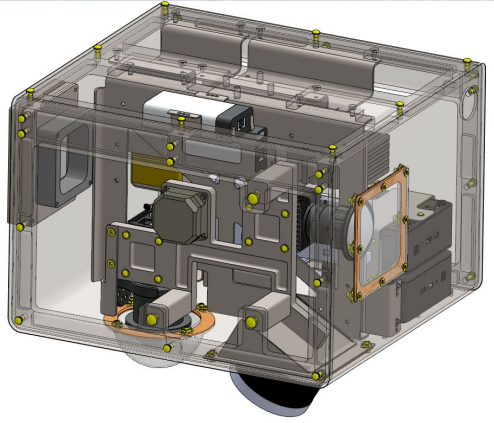


Example: Evaluating ORB-SLAM3



Project Plans

Collect & Share Bespoke & Crowdsourced Data



Development Pod

- Larger mass & volume for prototyping, iteration
- NASA or contract helicopters
- Scripted scenarios & passive data collection
- Auxiliary data



Crowdsourcing Pods

- Optimized mass & volume
- External partner fleet helicopters
- Passive data collection
- Seek approval under FAA's NORSEE policy

**Early flight data in an operational environment
will determine requirements for the
crowdsourcing campaign**

Preliminary Flights for Risk Reduction

Surrogates for eVTOL



Sample datasets to prompt stakeholder feedback

Develop operations & data management

Establish process for data publication

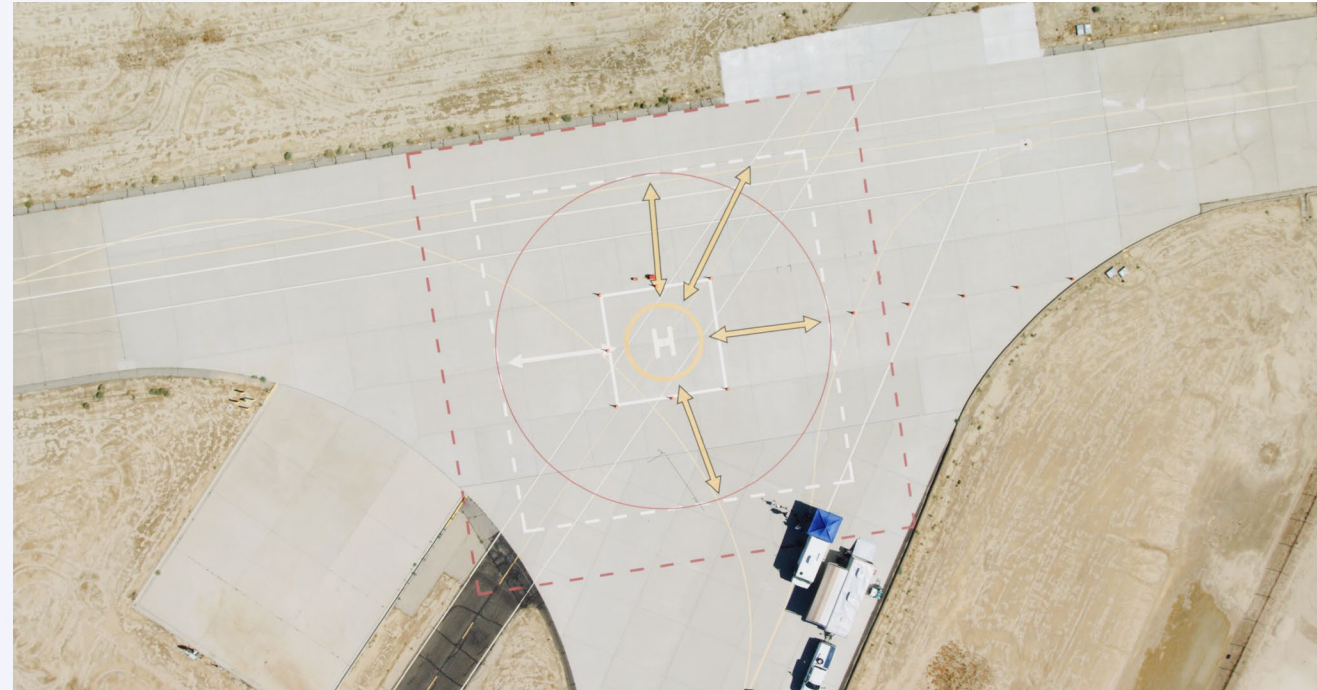
Repurposed hardware limitations

- Coarse time-alignment of video with aircraft state
- HD 1080p camera resolution, 30 fps framerate
- Low sample rates on instrumentation
- Integer-degree turret joint angles, camera pointing angle uncertainty



sUAS Approach Trajectory

01H helipad at NASA Armstrong Flight Research Center



Initiated each approach 1500 ft (460 m) downrange at 250 ft (76 m) AGL



National Aeronautics and Space Administration

sUAS Landing Area

01H helipad at NASA Armstrong Flight Research Center



Pulse Light Approach Slope Indicator (PLASI)

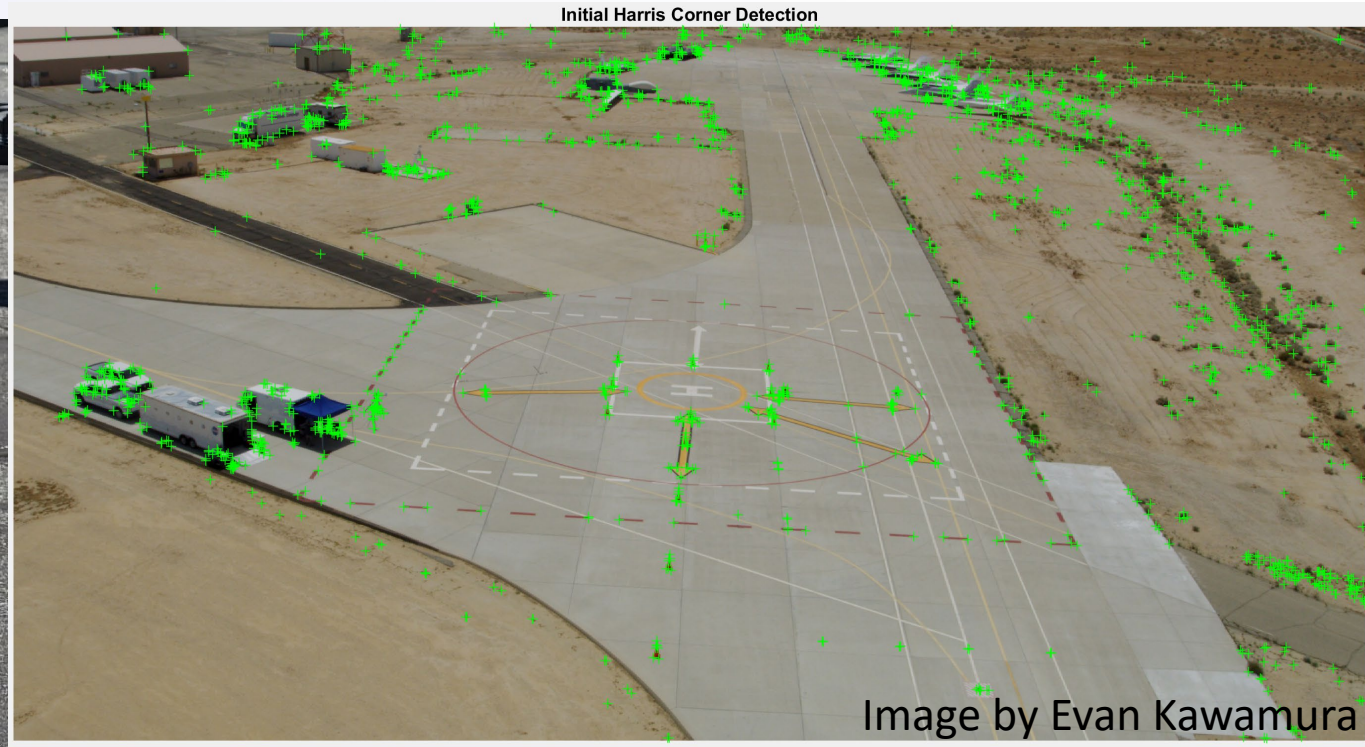
Traffic cones as “lights”

Surveyed TLOF, FATO, & SA



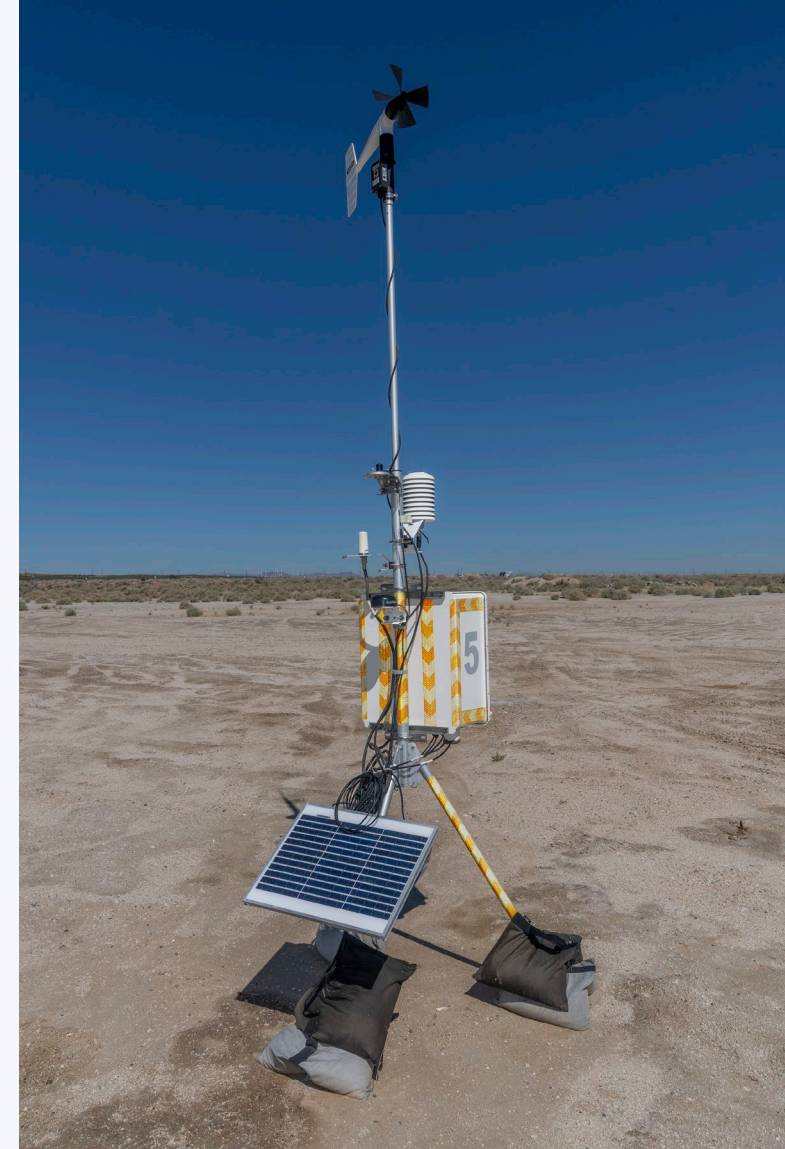
sUAS Platform

Previous NASA work compared VSLAM algorithms to ground truth



Meteorological Data

Weather stations & SODAR wind profiles



T³

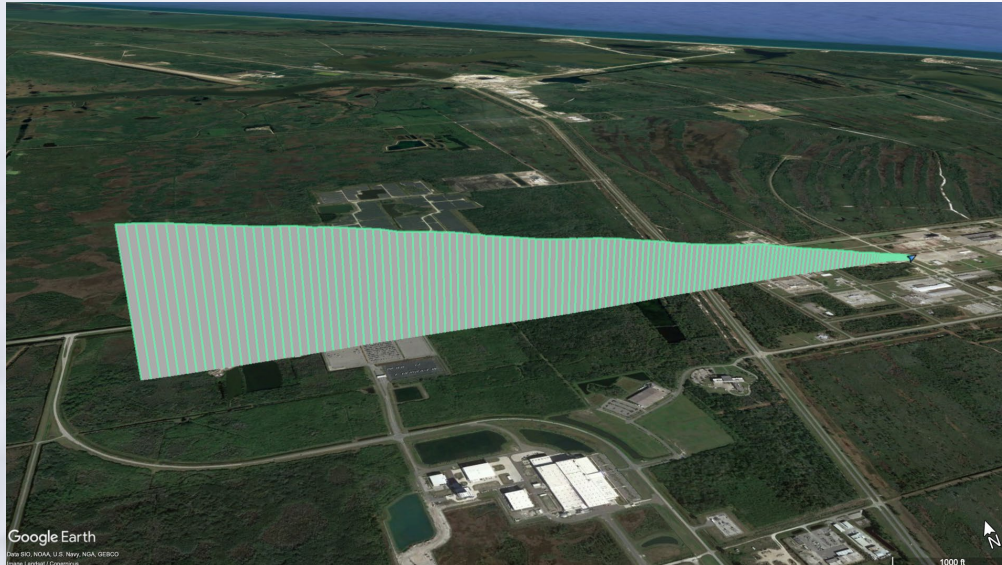
Helicopter Trajectories

Kennedy Space Center & Melbourne, FL

Starting 2.0 nm (3700 m) downrange,
2000 ft (600 m) & 1500 ft (500 m) AGL

Ground level OHF helipad & elevated platform

Various lighting conditions: dawn, midday, dusk, night



Helicopter Flight Data

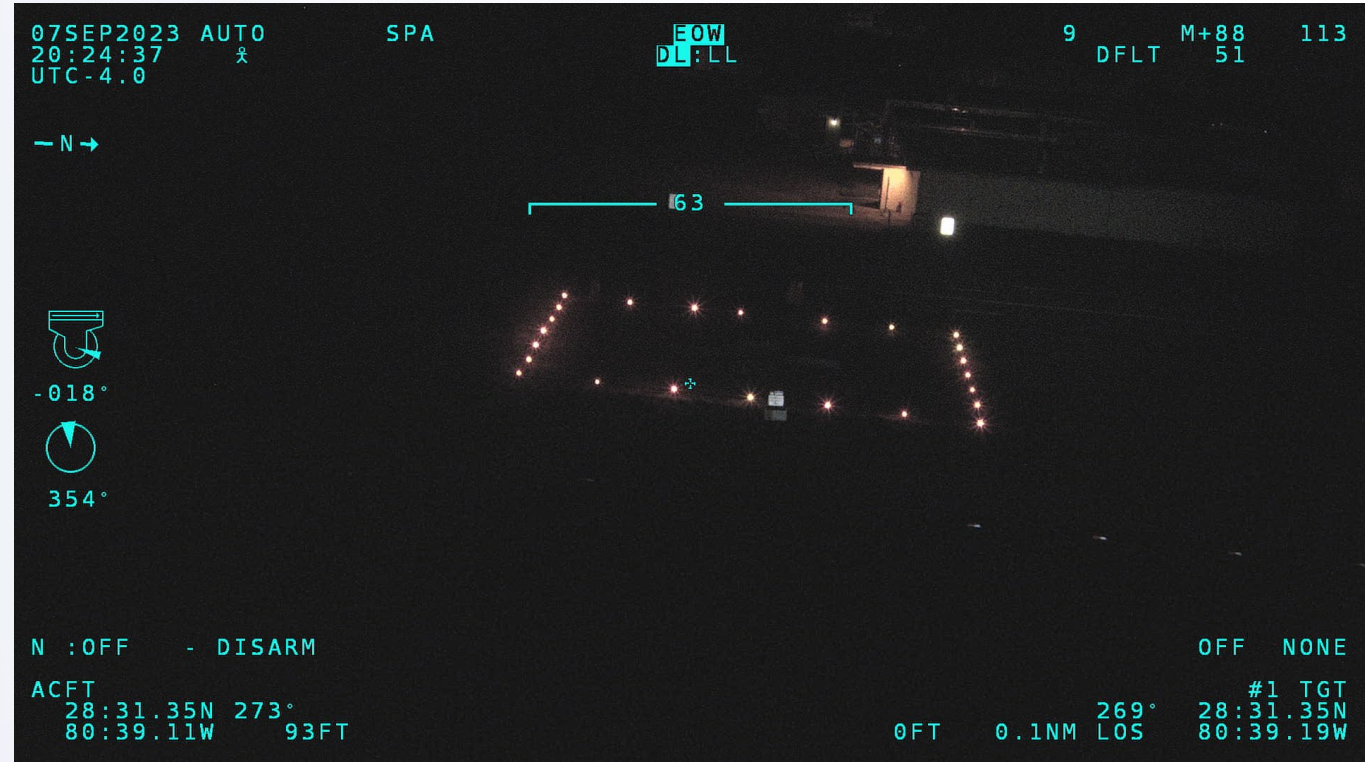


Airbus H135 flight data recorder

- Thank you to NTSB for CIDER software

WESCAM MX-10 data overlay

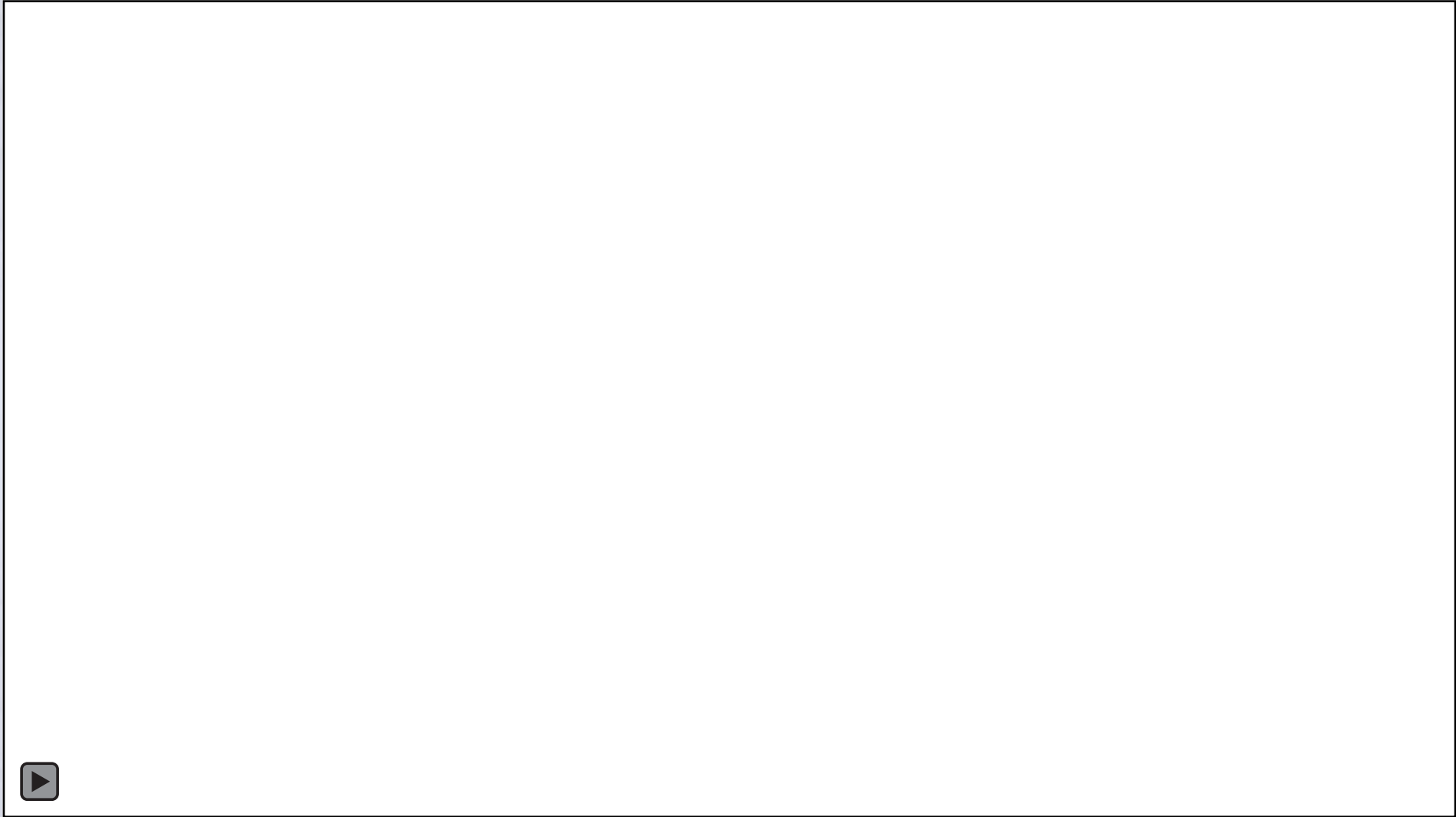
- OCR for time, pan & tilt angles



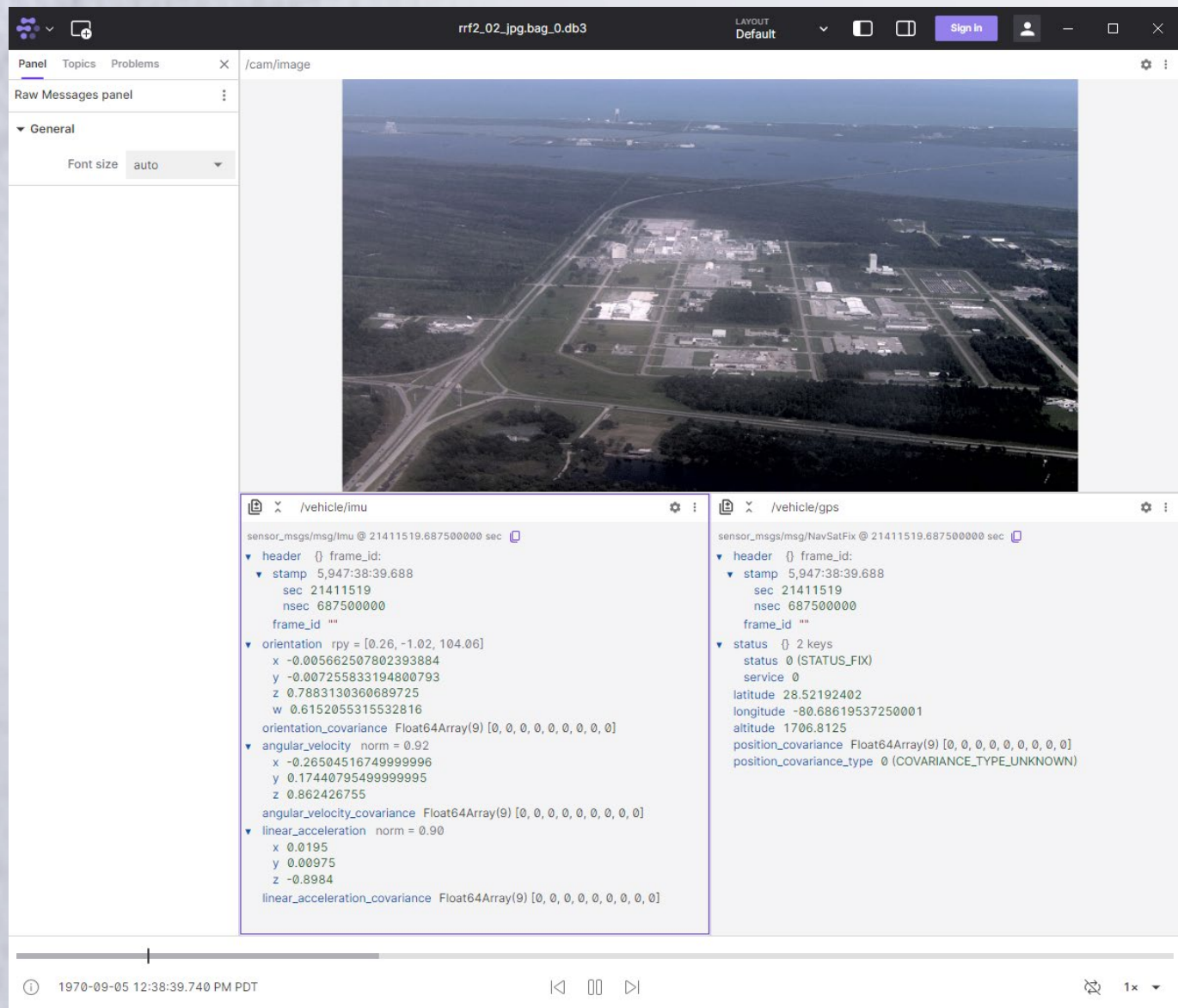
Sample Images from Preliminary Flights



Sample Video of Elevated Platform Landing



Data Formats



ProRes 422

PNG

HDF5

ROS2 bags

CSV

Camera Calibration Imagery

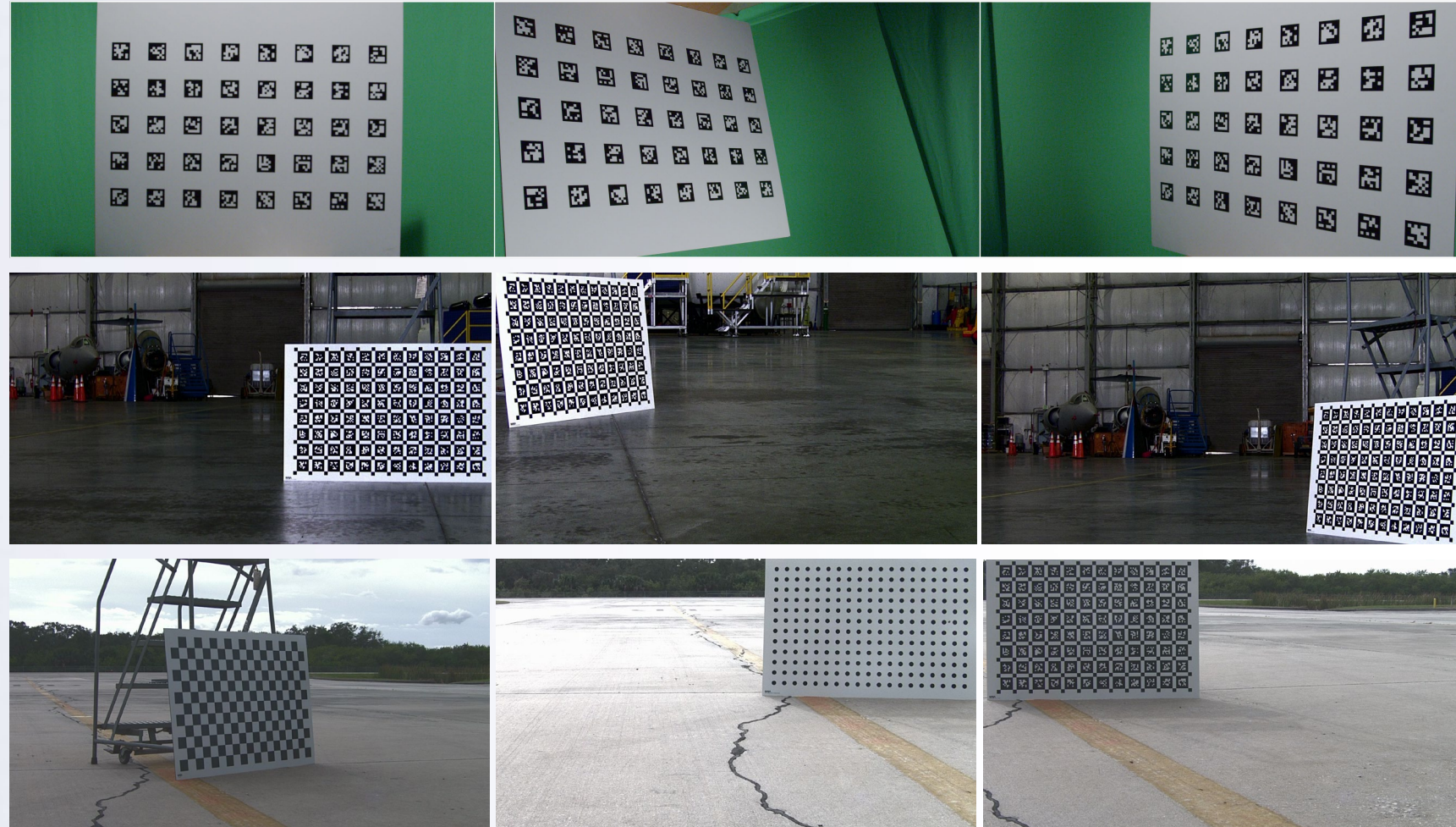


MATLAB April tag grid

Kalibr April tag grid

Checkerboard

Circle Grid



Future Work

Your feedback is requested!

Fixed cameras & LIDAR

- Forward & downward
- Prime lenses (fixed focal length)
- 4K at 60 fps
- Shutter triggered by INS-GPS updates
- Precision timestamps

Download datasets & give feedback

- <https://nari.arc.nasa.gov/ttt-ram/data>

